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U. S. DEPARTMENT OF  
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FARMERS' BULLETIN No. 1296

CHANGES  
EFFECTED  
by TRACTORS  
" on "  
Corn-Belt Farms



The following series of six bulletins has been prepared under the direction of the committee on farm power, appointed by the Secretary of Agriculture, to represent the Bureau of Agricultural Economics, Bureau of Public Roads, and the Bureau of Animal Industry, in a cooperative study of all phases of the farm power problem:

Farmers' Bulletin 1295: What Tractors and Horses Do on Corn-Belt Farms.

Farmers' Bulletin 1296: Changes Effected by Tractors on Corn-Belt Farms.

Farmers' Bulletin 1297: Cost of Using Tractors on Corn-Belt Farms.

Farmers' Bulletin 1298: Cost of Using Horses on Corn-Belt Farms.

Farmers' Bulletin 1299: Shall I Buy a Tractor? (For a Corn-Belt Farm).

Farmers' Bulletin 1300: Choosing a Tractor. (For a Corn-Belt Farm).

This bulletin, which is No. 2 of the series, shows the possibilities of reducing man labor and work stock. The changes which may occur in the cropping system, size of fields, and livestock enterprises are also pointed out.

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# CHANGES EFFECTED BY TRACTORS ON CORN-BELT FARMS.

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WITH THE ADDITION OF A TRACTOR to the farm, as with any other major item of farm equipment, a reorganization of a more or less important nature, or some change in operation, must be made if the tractor is to be profitable. It is obvious that a tractor will not be profitable if it does not enable the farmer to do at least one of the following things: (1) Reduce the number of work stock on the farm; (2) reduce the amount of hired help required; (3) farm an increased acreage; or (4) increase the amount of crops produced.

It is the purpose of this bulletin to show how tractors have been responsible for changes on the Corn-Belt farms where they are owned. With this information, the man who is trying to decide whether to buy a machine will be enabled to determine approximately what influence the tractor may have on his farm, and the man who already owns one will be able to compare the results which he has obtained with those obtained by others.

## REDUCTION IN NUMBER OF WORK STOCK.

The motive power to operate an ordinary farm may consist of horses or other draft animals entirely or of horses and a tractor. Singly or in combination, these furnish the power plant for farm work. Irrespective of other influences, many farmers who buy tractors for drawbar work do so with the idea that they will be able to dispense with a number of horses, thus reducing the animal power by an amount comparable to that added by the mechanical power, and that the sale of these horses will offset, partially at least, the investment in the tractor.

There is no way of determining in advance the actual number of work stock that can be disposed of on farms in general when tractors are bought. So many different conditions are found on Corn-Belt farms and the adaptability and reliability of various tractors varies so that it is impossible to lay down any rule in this regard.

The possible reduction in work stock after the purchase of a tractor depends upon the number of work stock already on the farm, the work to be done with the tractor, that which will still be done with horses, and the possibility of hiring extra power during rush periods.

The United States Department of Agriculture at various times in its studies on tractors has obtained information showing the reduction in work stock after the purchase of tractors on Corn-Belt farms. In an investigation in 1917 and 1918 covering 643 Illinois farms on which tractors were owned (see Farmers' Bulletin 963, *Tractor Experience in Illinois*), it was found that about three-fourths of the men who were farming the same number of acres as previously had disposed of some of their horses. In these instances the horses dis-



FIG. 1.—The average tractor in the Corn Belt has displaced slightly more than two head of work stock.

placed by the tractor averaged about four and represented about three-fifths of the cost of the tractor outfit.

In an investigation made in 1920 on 286 farms in Ohio, Indiana, and Illinois (see Department Bulletin 997, p. 58), it was found that 172 men who had not changed the size of their farms after the purchase of tractors had disposed of a total of 386 head of work stock, an average of 2.2 head per farm. (See Fig. 1.) Of the 172 men—

- 44 still kept the same number of work stock,
- 21 had disposed of 1 head,
- 41 had disposed of 2 head,
- 24 had disposed of 3 head,
- 19 had disposed of 4 head,
- 10 had disposed of 5 head,
- 8 had disposed of 6, and
- 5 had disposed of more than 6 head.

It may have been that some of the men who were still keeping the same number of work stock had not had enough before purchasing the tractor properly to carry on their work. However, on most Corn-Belt farms the work which requires the largest amount of power in the shortest time is plowing and fitting ground in spring, and as all tractors are especially suited for this work, operators of such farms should be able to make some reduction in the number of work stock.

The construction of most four-wheeled and crawler types of tractors is such that they are not satisfactory for cultivating corn. When such a machine is bought the number of horses that it will be necessary to retain is the maximum required for the cultivation of corn and for other work coming at the same time. With the purchase of a general-purpose machine, which can be used for cultivating corn, additional horses may be disposed of, provided a cultivator for use with the tractor also is provided. If the corn is to be cultivated with horses, it will usually be necessary to retain at least one head for each 20 acres of corn.

While machines made by well-established manufacturers, and for which repairs and service can be obtained without delay, are uniformly reliable, the purchaser should take nothing for granted and should satisfy himself as to the reliability of the machine he buys before disposing of any horses. The number of horses disposed of can sometimes be increased in the second and third year of ownership, when the operator has become more proficient in the uses of his tractor.

An occasional farmer finds it more profitable to hire teams or possibly a tractor for short periods during the rush seasons than to keep extra horses throughout the year for a few days of work. Where horses are available for hire it will be possible to reduce the number kept on any farm, irrespective of the tractor question.

An investigation made in 1918 on 141 Corn-Belt farms showed that on 22 some horses were hired during the year. This practice was highly recommended by these men, as it generally saved a team and all its necessary costs, such as investment, harness, feed, and care.

Twenty-three of the men on the 286 farms in Ohio, Indiana, and Illinois hired some horse labor during the year, amounting to about 13 days per farm and costing \$1.60 a day per head. From the experience of these men it would seem that when it is possible to hire extra power during the rush season, the practice is desirable.

If the number of work stock is not reduced to the minimum after the purchase of the tractor, the amount of work per head done during the year by the remaining work stock is frequently reduced. On many of the 286 farms mentioned above it was found that the number of work stock had not been reduced to the minimum and that consequently the total cost of power for operating such farms was greater than necessary. On 27 of these farms the horses worked more than 100 days per year, but on all the farms they worked an average of only 69 days per head per year, and on 20 of the farms they did less than 40 full days' work.

While it is not possible materially to increase the total number of days' work per year which the horses may do, it should be the object of every farmer to keep his horses at some productive work as much as possible. An increase in the number of days of horse labor annually, however, does not decrease the yearly cost of this form of

power. (See also Farmers' Bulletin 1298, Cost of Using Horses on Corn-Belt Farms, p. 12.)

A saving of feed for the remaining work stock may also be effected. On farms where tractors are owned the horses are often idle most of the time when the horses on other farms are being used daily for the heavy work of plowing and preparing the seed bed. During such times the horses are on pasture or receive only a light ration of grain and hay.

OPERATION	ACRES PER DAY	DAYS REQUIRED TO COVER 100 ACRES		
		10	20	30
PLOWING	3-PLOW	8.6		
	2-PLOW	6.5		
	HORSES	2.7		
DISKING	3-PLOW	30.8		
	2-PLOW	21.6		
	HORSES	16.7		
HARROWING	3-PLOW	51.4		
	2-PLOW	39.0		
	HORSES	26.3		
CUTTING GRAIN	3-PLOW	23.2		
	2-PLOW	19.7		
	HORSES	15.6		

FIG. 2.—Time required for different operations when performed with tractors and with horses.

### SAVING IN MAN LABOR.

The ability of the tractor to do more work in a given time than is usually done with horses, the combining of different operations, such as disking with harrowing, rolling, planking, or packing, and the performance of work at more opportune times, enables many farmers to do some of their work in considerably less time than were they using horses.

The size of the farm and the crops raised govern to a large extent the amount of saving that can be effected in man labor by the use of a tractor. Where farms are large enough to require hired help, it will often be possible to eliminate one or more men for a part of

the year at least. Where the farm is run by the operator and the help of the family, while it may not be possible to eliminate any help, it will be possible to do the work in less time or farm additional land with the same help.



FIG. 3.—One man with two-plow tractor (upper) will cover 6.5 acres per day, while one man with the same sized plow and five horses (lower) will cover a little less than 5 acres per day.

Figure 2, based on the 1920 survey of 286 farms in Ohio, Indiana, and Illinois, shows the days required by one man to cover 100 acres when using tractors and horses for different operations. (See also Fig. 3.) With the rate of doing work when using horses the same as given in this chart, the drawbar work which the average two-

plow tractor did on these farms in 26 days and the average three-plow tractor in 20 days, would have required 50 to 55 days for one man with horses. Thus the two-plow machine saved on the average 25 to 30 days of man labor during the year and the three-plow machine 30 to 35 days.

Farmers generally have a very definite knowledge of the acreage covered per day in different operations. The acreage covered per day by horses for the operations as shown in Figure 2 represents the work done by teams in units used on these particular farms. However, there are farmers who use teams in larger or smaller units than those here represented. For such men the daily duty of a man and horses when performing these operations will vary from the figure given. By comparing the acreage covered with the team units which he uses with that done by the two and three-plow tractors, any farmer can determine the amount of time that either size of machine will save for him on any given operation.

There are some farmers, perhaps, who could profitably use larger team units than they are now employing, thus increasing the amount of work done per day by one man. The use of a gang plow drawn by five horses instead of a sulky drawn by three, or the use of a double disk in place of a single disk, are examples of where larger team units could be substituted for those now in use on some farms. In considering the saving in time effected by the tractor owing to its ability to pull large implements, it might also be well for the farmer to consider the saving in time effected by having one man use more horses and larger implements on some operations.

With the saving in time which is effected by the use of a tractor, it will be possible for many farmers who purchase machines to increase their crop acres a certain amount without increasing the number of days' work per year over the number required per year when farming entirely with horses.

In the Corn-Belt survey made in 1918 it was a common thing to hear a farmer say that his tractor was bought so that the farm work could be done with the help available; that otherwise some of his land would have been idle. Of 204 Illinois farmers who in 1918 answered the question, "How much saving in hired help does the tractor effect and what is the value of such saving?" 175 reported some saving of hired help, and 29 reported no such saving.<sup>1</sup>

While a saving in hired help may be effected on many farms, especially in the spring, it is seldom possible to dispense with help over the entire working season. Where help has been required for cultivating corn, the purchase of a tractor will not eliminate hired labor for this operation unless (1) the tractor is suitable for use in cultivating; (2) unless 2-row cultivators are substituted for the 1-row outfits; or (3) unless the acreage in corn is decreased so that it can be cultivated by the operator and the family help. The only saving of help when it is needed in the harvest field is in the length of time such help will be needed.

Unless a mechanical picker or corn binder is owned and the tractor is used to pull the machine, it is obvious that the tractor will not save hired help in corn harvest.

<sup>1</sup> The saving effected by the tractor for these 175 men amounted to an average of \$148 for the year covered by the investigation.

## INCREASE IN SIZE OF FARM.

When an operator has become accustomed to using a tractor he generally finds that he is able to do more work in a given time than he formerly did with horses. Many farmers after purchasing tractors increase the size of their farms either by purchasing or renting additional land close by. However, it is not always possible to increase the size of the farm. The land may not be available in the near vicinity and it does not pay to go any great distance from the home farm to obtain additional land.

In many instances the increased crop acreage is handled with the same number of horses and men as were used on the smaller acreage, and it sometimes happens that a larger crop acreage is handled with fewer horses and the same number of men.

An investigation conducted by the United States Department of Agriculture in 1917 and 1918 showed that of 629 tractor owners in Illinois there were 186, or 30 per cent, who increased the size of their farms after buying tractors an average of 84 acres per farm. On the 141 Corn-Belt farms studied in 1918, there were 36, or 26 per cent, which had been increased in size, the increase averaging 120 acres per farm. (See Table 1.)

TABLE 1.—*Size of farm before and after purchase of tractor (arranged according to size of farm after purchase of tractor).*

[Corn-Belt survey, 1918.]

Size of farm.	Number of farms.	Average size after purchase of tractor.	Average size of farm before purchase of tractor.
Under 140 acres.....	10	120	125
141 to 220 acres.....	36	174	187
221 to 300 acres.....	35	258	244
301 to 380 acres.....	16	333	315
381 to 540 acres.....	18	454	387
541 to 700 acres.....	16	629	550
701 acres and over.....	10	878	841
Average.....	141	346	324

The farms of under 140 acres and those from 141 to 220 acres show a decrease in size, owing to the fact that there were in this group several renters who, in moving, were unable to obtain as much land as they had previously farmed.

Table 2 shows similar figures for the different areas where the investigation was made on the 286 farms in 1920.

TABLE 2.—*Size of farm before and after purchase of tractors in different areas.*  
[Ohio, Indiana, and Illinois, 1920.]

Area.	Present average size of farm.	Average size of farm before purchase of tractor.	Area.	Present average size of farm.	Average size of farm before purchase of tractor.
	Acres.	Acres.		Acres.	Acres.
Madison County, Ohio.....	363	317	Livingston County, Ill.....	247	240
Seneca County, Ohio.....	202	182	Knox County, Ill.....	256	236
Madison County, Ind.....	218	199	Average of all farms.....	258	238
Montgomery County, Ind.....	270	252			

It will be noted that on these farms there had been an average increase of about 20 acres since the tractors were purchased. Nine of the 286 men had started farming with tractors, 81 had increased the size of their farms since purchasing tractors, 24 had decreased the size of their farms, and there had been no change in acreage on the remaining 172. All of those who were farming smaller acreages than before the purchase of tractors were renters who had moved to smaller farms, or were owners who in 1920 rented out some ground which they had formerly farmed themselves. On the average, these 24 men were farming 84 acres less than they formerly did. The 81 men who increased the size of their farms did so by an average of 90 acres.

The results which have been obtained by these men should indicate fairly well what can be expected on farms in sections of the Corn Belt where it is possible to rent additional lands and where tractors have just been bought or the purchase of a machine is being considered.

#### CHANGE IN CROPPING SYSTEM.

With a reduction in the number of work stock, an increase in the size of the farm, or both, a change in the cropping system may be desirable. This change may be simply the increase in acreage of certain crops sold from the farm, the decrease in acreage of crops grown for feed, or the elimination or addition of a certain crop or crops.

As a general rule oats is not in itself a profitable crop, and is grown mainly because it is a most satisfactory horse feed and because it fits well into most rotation schemes. On some farms where the work stock has been reduced to two or three head, it might be more profitable to buy oats for feed than to raise it. On a number of Corn-Belt farms where the horses have been reduced to a minimum number and other livestock do not require it in any large amount, hay is not raised, but bought from other farmers. Fifty-nine of the 286 farmers previously mentioned raised no hay in 1920, buying all they needed from others.

Where the size of the farm is increased, the added acreage may be sufficient to justify a change in the rotation. For example, instead of a rotation of three or four years, it may be increased to four or five years. However, a similar change may sometimes be effected when acreage has not been increased.

#### CHANGE IN SIZE OF FIELDS.

On some farms where small fields exist and the lay of the land permits, it may be economy to enlarge the fields by throwing one or more together after the purchase of a tractor. The larger the fields the less turning there will be to do, and in plowing the plow bottoms will be out of the ground less time at the ends of the fields. This will mean an increase in the amount of work accomplished every day. Either tractor or horses will do the same work in less time under similar conditions in a 60-acre field, for example, than in two 30-acre fields.

If the farm acreage is increased by the addition of land adjoining the farm, it will often be possible to enlarge the size of some of the

fields at least by using this added acreage. Wagon roads, railroads, irregular boundaries, streams, and sloughs sometimes make the desired enlargement impracticable.

### CHANGE IN LIVESTOCK ENTERPRISES.

The number of farms upon which tractors are owned is small compared with those operated by horses, hence the effect of mechanical power on livestock enterprises is seldom noticeable in a community or section as a whole. On many farms where tractors are owned, however, the machines have been directly or indirectly responsible for a change in livestock enterprises.

Where a tractor is owned the mares usually do less of the heavy work than they formerly did, therefore it should be possible to produce more colts. It should be the intention of most of these farmers at least to replenish their work stock with colts of the best quality. There is a larger percentage of mares to geldings on the 286 farms studied in Ohio, Indiana, and Illinois than of all mares to geldings in these districts. This indicates that when disposing of surplus work stock these farmers sold more geldings than mares. However, since there was only 1 colt to every 10 mares on these farms, about the census ratio for all farms in the region, the tractor had evidently not materially affected the production of colts.

Where there is permanent pasture on a farm, or the acreage in pasture is not changed to conform to a change in work stock, these pastures may be capable of carrying additional head of other livestock in lieu of horses displaced. With an increase of acreage and a corresponding increase in total yield of grain, the farmer can increase the number of various kinds of livestock kept if he desires to market all his grain on the hoof.

### MACHINERY.

The purchase of a tractor will generally necessitate the purchase of a certain amount of machinery for use with it, unless it is only to be used on the belt or unless the necessary implements are already owned. While some of the horse-drawn machines can be used, it will not be practicable to depend altogether on this machinery, for on some operations it will not be heavy enough to do the work. When such machinery is used, it will be necessary to buy or have made the necessary tractor hitches to draw the machine, as, for example, the horse-drawn binder.

Practically every farmer buys some machinery to go with his tractor. This usually consists of one or more of the following: Plow, disk, roller or packer for drawbar work, and silage cutter, husker, shredder, corn sheller, or separator for belt work. (See Fig. 4.)

As most tractors are purchased with the idea of doing as much of the plowing as possible, it will be necessary to purchase a plow corresponding in size to that of the tractor. Horse-drawn plows are not satisfactory for use with a tractor. Being of lighter construction than regular tractor plows, they will not always stand the strain placed upon them when pulled under a heavy load. Some men have used their horse-drawn plows with tractors, but more satisfactory work is accomplished when a tractor plow is used.

Heavy tandem disks are manufactured to use with tractors, and while these perhaps do better work, many operators still use their horse-drawn disks, both single and tandem. To make the horse-drawn disks do better work, they are most frequently loaded down with stones to give them extra weight when pulled by the tractor.

The old horse-drawn harrow, planker, roller, or packer can be used with the tractor. Where these implements are owned it will not be necessary to purchase new ones to use with the machine, except an extra section or two of spike-tooth harrow when not enough sections are already on hand to use with the tractor.

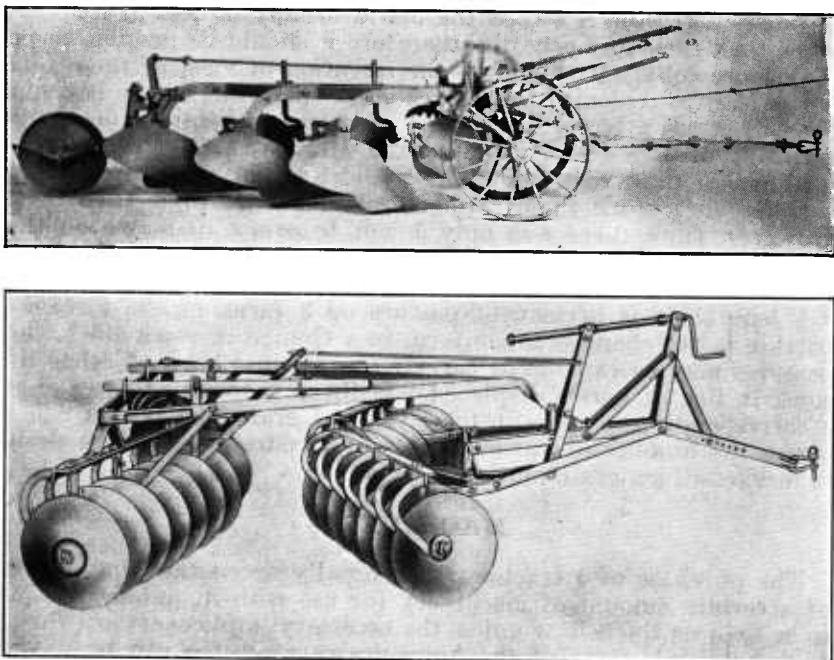


FIG. 4.—The machinery a farmer usually purchases to go with his tractor consists of a plow and disk.

Horse-drawn cultivators are not often satisfactory for use with the tractor. In the hay field, whatever the operation may be, the horse-drawn machinery can generally be used when the necessary hitch is provided. The grain and corn binder can both be pulled by the tractor and the work done in a satisfactory manner. Many operators use other horse-drawn machines with their tractors, such as drills, corn pickers, and manure spreaders.

Very often several neighboring farmers, one of whom owns a tractor, buy one or more belt machines cooperatively. The purchase of a grain separator under such circumstances has generally proved very satisfactory. Farmers interviewed have spoken highly of the practice, for it enables them to do their thrashing when they are ready, without the use of outside help or waiting a long period

for their turn in a thrashing ring. When the thrashing has all been done for those men having a share in the outfit, outside work is often done and the profits divided among the owners.

When machinery manufactured for use with a tractor is purchased, some farmers dispose of the horse-drawn equipment supplanted. Often, however, this old machinery is kept for an emergency or until the operator becomes acquainted with his tractor and feels that he will have no further use for it. Sometimes this horse-drawn machinery is worn out or nearly so, and has no sale value. Sixty-seven of the 286 farms mentioned above disposed of some of their horse-drawn machinery. The average amount realized by such sales was \$51.

### CONCLUSION.

The influences of a major character which the tractor will exert on the organization of the average Corn-Belt farm have been pointed out in this bulletin. On some farms where peculiar conditions may be present other changes of a minor nature may be made. Before stating definitely for any particular farm what these minor changes in organization might be, it would be necessary to know in detail everything of importance bearing on the present organization. Often these minor changes can not be foretold, but will develop naturally after the tractor has been in use some time and has been fitted into the work on the farm.

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